A 984 Mr Copy 3

United States
Department of
Agriculture

Agricultural
Marketing
Service

Marketing
Research Report
Number 1147

Modularization in the Frozen Food Industry

FEB 25 '87

Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

Contents

	Page
Summary	2
Introduction	3
Results	4
General	4
Vegetables	6
Meat, poultry, and seafood	7
Other categories	9
Discussion	11

Summary

In a study conducted at a large food wholesaler it was found that there were 604 case sizes used to ship 891 food items in 16 frozen food categories. The frozen food industry believes that the number of sizes used far exceeds an efficient number. Not only is the number excessive but also very few cases are modular to the 48- by 40-inch shipping platform. The use of excessive nonmodular case sizes results in added physical distribution costs.

Forty-nine possible case sizes were identified as possible substitutes for the cases now used. These 49 are based on 16 modular sizes (table 6) that are compatible with the 48- by 40-inch shipping platform and on four potential alternative heights (5, 7.5, 10, and 15 inches). Ninety-eight percent of the cases now used are within 2 inches in height, length, or width of the modular case sizes. The other 2 percent are within 2.5 inches. Substitution of the 49 modular case sizes for the 604 sizes presently used would provide a 92-percent reduction in the number of case sizes used.

The height of the modular unit (total height of cases and shipping platform) is another important factor. To date, heights of 22 and 45 inches have been recommended by some major frozen food processors.

Members of the frozen food industry must work cooperatively to reduce the number of case sizes used. The information in this report can provide a starting point. It will be up to the industry to make such a reduction a reality.

Acknowledgments

The authors thank all frozen food processors, public refrigeration warehouse personnel, wholesalers, and retailers who gave assistance in this project. Appreciation is also expressed to Samuel Thurston, Giant Food, Inc. and to members of the Modularization Task Force of the American Frozen Food Institute: Joan Huber, Southland Frozen Food, Inc.; William Filomena, General Foods Corporation; Gary Johnson, Stouffer Foods Corporation; and Len Ebersberger, Merchants Terminal Corporation.

Special thanks is also expressed to Scott Ramminger, Director of Communications, American Frozen Food Institute (AFFI), who helped in coordinating the work between AFFI and the U.S. Department of Agriculture.

Modularization in the Frozen Food Industry

By
Robert C. Mongelli, Bruce E. Lederer and Joseph P. Anthony[1]

The number of sizes of shipping cases used in the frozen food industry contributes to the rising packaging, handling, and transportation costs faced by producers, carriers, and receivers.

Modularization, a concept that geometrically relates shipping case sizes to one another and to a common unit size, offers a way to reduce the number of case sizes and types in use, thereby helping reduce frozen food marketing costs.

The frozen food industry generally uses the standard 48-by 40-inch shipping platform (pallet and/or slipsheet). Today the problem is that hundreds of case sizes are being used, and very few are modularly compatible with the 48-by 40-inch shipping platform.

Knowledge of the multitude of case sizes is not new. More than 30 years ago, L. C. Carey wrote "Standardization or simplification has been defined as reduction in industrial waste through the elimination of unnecessary sizes, types, and dimensions of manufactured products. Consequently, as a consumer, the average citizen pays a large part of the ultimate aggregate increased costs of marketing—that are attributable to avoidable waste—waste due to the greater expense of manufacturing a large number of different sizes and types of containers; waste inherent in the handling of odd-sized containers in transportation and in storage; and waste due to damage in transit and in the distributive process—."[2]

Sweden and Switzerland have used modularization with favorable results. Swedish officials have realized the following benefits:[3]

1. Damage losses have been reduced.
2. Handling has been reduced and made more efficient.
3. Transport costs have been cut by 15 percent.
4. Material costs have been cut.

In view of those reported benefits, the U.S. Department of Agriculture (USDA), in conjunction with the American Frozen Food Institute (AFFI), conducted a research study to—

[1]Agricultural economist, marketing specialist, and agricultural economist, respectively, with the Market Research and Development Division, Agricultural Marketing Service, U.S. Department of Agriculture, Washington, D.C.

[2]Carey, L. C. Containers in Common Use for Fresh Fruits and Vegetables. Farmers Bulletin 2013, USDA Production and Marketing Administration.

[3]Comptroller General Report to the Congress, Redesigning Shipping Containers to Reduce Food Costs. GAO, CED 78-81, 1978.

Results

- determine the extent of proliferation of frozen food cases;
- determine the possibility of reducing these numbers; and
- identify potential modular replacements.

The major purpose of this report is to detail the generally inadequate utilization of the surface area of the standard 48- by 40-inch shipping platform (pallet or slipsheet) by vast numbers of the frozen food case sizes commonly used, and to describe how the selection of potential alternative, modular case sizes could greatly reduce the number of sizes now in use without changing the present sizes of most cases by more than 2 inches in length, width, or height.

All dimensions mentioned in this report are outside dimensions, with a 1-inch tolerance.

The results of the study will be presented generally and then by three major groups (vegetables; meats, poultry and seafood; and other categories) for easy analysis of the data.

General

This report details results from a study of frozen food cases at one large food wholesale firm in Maryland that handles an extensive line of frozen food items. The firm handled 891 frozen food items shipped in 604 case sizes. Information supplied by three other large wholesalers in Texas, California and Illinois indicated that they carried frozen food lines ranging from 875 to 1050 items. Therefore, it was assumed that a wholesaler carrying over 800 frozen items would indicate an extensive and fairly complete line of items.

The items identified at the firm studied were grouped into 16 categories (table 1) to help simplify the vast amount of case data to be studied. The vegetables category, with 193 items shipped in 124 case sizes, had the most items and case sizes. Because the data on case sizes used for the ice cream/ices category were incomplete, they were not included in the analysis.

Table 1.—Number of case sizes used and number of frozen food items by category

Category[1]	Number of items	Number of different case sizes used
Vegetables	193	124
Ice cream/ices	41	-[2]
Seafood specialties[3]	105	83
Nationality foods	96	68
Desserts	77	62
Poultry specialties[4]	70	52
Poultry	70	41
Meat	67	51
Dinners	44	30
Beverages	42	21
Breakfast foods	27	21
Breads	23	18
Seafood	14	12
Fruit	13	13
Snacks	5	4
Miscellaneous	4	4
Total	891	604

[1]Some frozen food items could be placed in more than one category. For example, a Mexican dinner was placed in the Nationality food category, but also could be placed in the dinners category.
[2]Data on case sizes were incomplete, and therefore, not considered in the analysis.
[3]Items that contain seafood but with some further processing, for example, breaded fish sticks.
[4]Items that contain poultry but with some further processing; for example, breaded chicken patties.

Table 2 shows the ranges of case heights, length and widths and the number of sizes within those ranges. For example, the height dimension ranged from 3 to 18 inches, with 24 heights within the range.

More than 78 percent of the frozen food items are shipped in cases with heights ranging between 5 and 10 inches, that included 11 case heights. Case height is an important consideration. The use of many heights greatly reduces the chances of properly stabilizing a mixed load for shipment.

Table 3 shows the cases used to ship individual items. For example, one product item per case is shipped in each of the 389 case sizes. In contrast, 17 different items are shipped in one case size. Is one item per case size too much specialization? The devotion of one case size to only one item leads to the use of hundreds of case sizes. The members of the industry that created this situation must now work together to rectify it.

The 604 case sizes (differences in height, length, and width) found at the wholesaler studied involved 272 combinations of lengths and widths. The length and width of each case was analyzed to determine how much of the 48- by 40-inch shipping platform's surface is utilized when a layer of each given case size is placed on it. Only five (1.83 percent) of the 272 combinations utilized 100 percent of the platform's surface. These cases were used to ship only 19 different frozen food items, (2.13 percent of the 891 items handled by the wholesaler studied).

Table 4 shows the percentage of cases and items for different ranges of surface utilization. For example, 23.73 percent of the case sizes in the study utilize 85 to 89 percent of a 48- by 40-inch shipping platform's surface, and

Table 2.—Range and number of case sizes by height, length, and width

Dimension	Range of case sizes	Number of case sizes
	Inches	*Number*
Height	3—18	24
Length	5.5—27.5	44
Width	5.5—25.5	40

Table 3.—Case sizes used to ship individual frozen food items

Frozen food items	Case sizes used
Number	*Number*
1 item	389
2 items	83
3 items	27
4 items	16
5 items	11
6 items	6
7 items	2
8 items	2
9 items	1
10 items	2
11 items	1
13 items	1
17 items	1

Table 4.—Percentage of cases and items falling within specific utilization ranges

Range in percentage of surface utilization	Percentage of cases[1]	Percentage of frozen food items
Percent	*Percent*	*Percent*
95—100	9.86	11.71
90— 94	21.17	20.91
85— 89	23.73	23.53
80— 84	18.62	19.44
75— 79	14.60	15.44
70— 74	7.66	7.05
65— 69	2.91	1.36
60— 64	0.0	0.0
55— 59	.36	.22
50— 54	1.09	.34
	100.00	100.00

[1]Based on 272 cases (length and width only).

only 9.86 percent of the cases utilize 95 to 100 percent. More than 45 percent of the cases utilize less than 85 percent of a shipping platform's surface, and more than 12 percent utilize less than 75 percent. Readers should study these figures carefully; they are very important. The frozen food industry can realize great savings by improving case utilization of the shipping platform's surface.

Table 5 lists 16 case sizes that utilize 100 percent of a shipping platform's surface and the number of cases per layer needed for such utilization. These cases range in surface area from 64 square inches (8- by 8-inches) to 480 square inches (24- by 20-inches).

Case sizes handled at the wholesaler studied ranged from a 55.25 square-inch (6.5- by 8.5-inch) case used for shipping only one particular item, to a 533-square-inch (26- by 20.5-inch) case used for shipping whole frozen turkeys. It can be seen that the smallest and the largest case sizes among the 16 that utilize 100 percent of a shipping platform's surface are compatible with the largest and smallest case sizes found at the wholesaler studied.

Table 5.—Sixteen case sizes that utilize 100 percent of the surface area of a standard 48- by 40-inch shipping platform and cases per layer

Case size[1]		Surface area of case	Cases per layer
Length	Width		
Inches	*Inches*	*Sq.inches*	*Number*
8	8	64	30
10	8	80	24
12	8[2]	96	20
12	10	120	16
16	6	96	17
16	8[2]	128	15
16	10[2]	160	12
16	12[2]	192	10
20	6	120	16
20	8	160	12
20	12	240	8
20	16	320	6
24	8	192	10
24	10	240	8
24	16[2]	384	5
24	20	480	4

[1]Outside dimensions.
[2]Case sizes handled by the wholesaler studied.

Vegetables

The vegetable category, the largest frozen food category, comprises more than 20 percent of all frozen food items in retail stores. A survey, conducted by the authors, of 15 food retail stores in the Washington, D.C. area revealed that almost 21 percent of the retailers' freezer display area is allocated to frozen vegetable items, more than for any other category. More than 20 percent of the case sizes used to ship frozen foods are used to ship items in the vegetable category.

Table 6 shows the percentage of different surface areas of a 48- by 40-inch shipping platform utilized by cases used for vegetable items. This table shows that 16 percent of the cases utilize 95-100 percent of the shipping platform surface. The average surface area utilization was 87 percent.

Based on the data collected at the frozen food wholesaler studied, 66 percent of the vegetable items[4] cube out[5] in a highway trailer[6] when shipped on twenty 48- by 40-inch shipping platforms before the maximum shipping weight of 45,000 pounds is reached.

Table 7 presents the weight ranges for cases and items that cube out before they weigh out in a straight trailer load.[7] For example, in a straight trailer load only 47 items will weigh out between 40,000 and 45,000 pounds. The average payload weight for all items that cube out in highway trailers is 31,400 pounds.

The data in tables 6 and 7 indicate that vegetable cases utilize 87 percent (average) of the shipping platform's surface, 66 percent of the vegetable items cube out in a trailer load, and an average payload weight is 31,400 pounds. Therefore, by utilizing more surface area of the shipping platform, utilization of the interior space of the trailer will be increased, thereby increasing the payload weight. This would result in increased efficiency and decreased costs.

The 124 case sizes used for frozen vegetables included 21 case heights ranging from 3 to 14 inches. For a reduction in the number of different case heights, four potential al-

[4]Assuming a nonmixed (straight) load.
[5]"Cube out" means that in a highway trailer carrying 48- by 40-inch shipping platforms, and assuming a nonmixed load, the trailer will be filled before the maximum payload weight of 45,000 pounds is reached.
[6]For the purpose of the study, the highway trailer was assumed to be refrigerated, 45 feet long, to have an exterior width of 96 inches, and to hold 20 shipping platforms.
[7]"Weigh out" means that in a highway trailer carrying 48- by 40-inch shipping platforms, and assuming a nonmixed load, the maximum payload weight of 45,000 pounds is reached before the trailer is filled.

Table 6.—Percentage of cases for frozen vegetables that utilize indicated surface areas of a 48- by 40-inch shipping platform

Category	Percentage of shipping platform surface utilized							
	65-69	70-74	75-79	80-84	85-89	90-94	95-100	Average surface utilized
	Percent							
Vegetables[1]	1	3	9	23	24	24	16	87

[1]Case dimensions include 79 combinations of length and width.

ternative heights were selected for this analysis based on heights now used. The heights selected were 5, 7.5, 10, and 15 inches. Twenty-two percent of the cases met exactly one of the four heights, and 72 percent were within 0.5 to 1 inch of one of the four heights.

The 124 case sizes included 23 lenghts ranging from 10 to 22 inches and 17 widths ranging from 5.5 to 16 inches.

The 124 case sizes were then compared with 16 modular case sizes for potential substitutes that are compatible with the 48- by 40-inch shipping platform. Ten of the 16 modular sizes, because of their dimensions in relation to existing case dimensions, seemed applicable for use for frozen vegetables. When the four alternative heights were considered, 26 case sizes (different combinations of height, length, and width) were chosen as possible substitutes for the 124 vegetable cases now used, a reduction of 79 percent. The chosen alternative sizes (table 8) differed from the 124 cases now used by no more than 2 inches in height, length or width.

Use of the modular cases should allow 100 percent utilization of shipping platform surface. Because average utilization with nonmodular case sizes was 87 percent, the use of modular cases should, theoretically, allow an increase of 13 percent in payload shipped or an increase from 31,400 pounds to 35,482 pounds in payload weight.

Meat, Poultry and Seafood

Frozen meats, poultry, and seafood account for almost 34 percent of the frozen food items found in full-line retail stores. The dollar value for these items exceeds $13 billion.[8] For transport of these items, 239 case sizes are used.

Table 7.—Weight ranges of cases for frozen vegetables[1] and number of items in each range

Weight ranges	Cases[2]	Vegetable Items
Weight	*Number*	*Number*
40,000—45,000	25	47
36,000—39,999	22	31
32,000—35,999	13	16
28,000—31,999	9	10
24,000—27,999	11	16
20,000—23,999	3	3
16,000—19,999	2	2
12,000—15,999	3	3
Total	88	128[3]
Average payload weight	31,400	

[1]Cases that cube out before they weigh out in a highway trailer. See text footnotes 5 and 7 for definition of "cube out" and "weigh out."
[2]Assuming a straight load of a particular case and item.
[3]The 128 items are 66 percent of the total vegetable items. See table 1.

Table 8.—Twenty-six modular case sizes identified as possible alternatives for frozen vegetable cases now used

Case length and width	Case height
Inches	*Inches*
10 by 8	5
12 by 8	5, 7.5
12 by 10	7.5, 10
16 by 6	5, 7.5, 10
16 by 8	5, 7.5, 10
16 by 10	5, 7.5, 10, 15
16 by 12	5, 7.5, 15
20 by 8	5, 7.5, 10
20 by 12	5, 7.5, 10, 15
20 by 16	7.5

[8]Frozen Foods Almanac, 1983.

Table 9.—Percentage of cases, by category, that utilize different surface areas of a 48- by 40-inch shipping platform

Category	Percentage of shipping platform surface utilized										Average surface utilized (percent)
	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-100	
	Percent										
Meat[1]	-	-	-	-	9	14	14	30	21	12	84
Seafood specialties[2]	-	-	-	-	5	8	18	34	22	13	86
Seafood[3]	-	-	-	-	9	9	27	46	9	-	84
Poultry specialties[4]	-	-	-	4	11	11	15	22	22	15	83
Poultry[5]	5	3	-	-	8	16	18	29	18	3	79
Average											83

[1]Based on cases with 43 different lengths and widths.
[2]Based on cases with 60 different lengths and widths.
[3]Based on cases with 11 different lengths and widths.
[4]Based on cases with 47 different lengths and widths.
[5]Based on cases with 38 different lengths and widths.

Table 10.—Number and percentage of items used, by category, that cube out[1] in a highway trailer, and average payload weights

Category	Items		Average payload weight (pounds)
	Number	Percent	
Meat	44	64	33,300
Seafood specialties	86	87	27,300
Seafood	13	92	26,400
Poultry specialties	61	87	32,500
Poultry	59	90	32,500
Total or average	263	83	30,300

[1]See text footnote 5 for definition of "cube out."

Table 9 shows the utilization of different surface areas of a 48- by 40-inch shipping platform by percentage of cases used to ship frozen meat, seafood specialties, seafood, poultry specialties and poultry.[9] Most of the cases for all five categories occupy between 85 and 89 percent of the shipping platform's surface, and no more than 15 percent of the cases in any of the five categories occupy more than 95 percent of the platform's surface. Surface utilization ranged from 79 to 86 percent for the five categories, with an average being 83 percent.

These results would not be as dramatic if the items shipped would weigh out in a straight trailer load. But this is not the case. Table 10 shows the percentage of packed items, by category, that cube out in a highway trailer before the payload weight of 45,000 pounds is reached, and the average payload weights. Percentages ranged from 64 percent for meat to 92 percent for seafood, and averaged 83 percent.

The average payload weight ranges from 26,400 pounds for seafood to 33,300 pounds for meat items. The overall average for the five categories is 30,300 pounds, which is about 67 percent of the maximum payload weight that a trailer can legally carry.

As was found for vegetables, the data in tables 9 and 10 indicate that the area of a platform's surface occupied by cases used to ship meat, poultry, and seafood should be increased.

The 239 sizes included 22 case heights ranging from 3.5 to 13.5 inches. Each of the 22 heights was compared with one of the four alternative heights. Twenty percent of the cases met exactly one of the four heights, and 75 percent of the cases were within 1 inch of one of the four heights.

The 239 case sizes also included 33 lengths ranging from 8.5 to 27.5 inches, and 29 width, ranging from 6.5 to 21.5 inches.

[9]Meat includes mostly beef items that have been processed, prepared, or that are the main part of entrees or dinners. Seafood specialties include seafood that has had some processing; for example, breaded fish sticks. Seafood is whole or in parts and unaltered. Poultry specialties include poultry that has had some processing; for example, breaded chicken patties. Poultry is whole or parts and unaltered.

As with the vegetable cases, the 239 case sizes used for meat, poultry, and seafood items were compared with the previously described 16 modular sizes and the four potential alternative case heights. All 16 of the modular sizes are applicable for frozen meat, poultry, and seafood. When the four alternative heights were considered, 41 case sizes (different combinations of height, length, and width) were chosen as possible substitutes for the 239 cases now used, a reduction of 83 percent. Ninety-six percent of the 239 case sizes now used differed from the potential substitute cases by no more than 2 inches in height, length, or width. The other 4 percent were within 2.5 inches. Because 23 of the 41 case sizes chosen were identified as substitutes for frozen vegetables, only 18 new case sizes need to be added to the total list. Three case sizes on the vegetable list were not needed for meat, poultry, or seafood.

Table 11 shows the 41 case sizes identified as possible alternatives for the meat, poultry, and seafood cases now used.

Other Categories

The remaining frozen food categories—nationality foods, desserts, dinners, beverages, breakfast foods, breads, fruits, snacks, and miscellaneous items consist of 331 items, and 241 case sizes are used in shipping them. As with the previously discussed categories, the number of case sizes used can potentially be reduced.

Table 12 shows the utilization of different surface areas of a 48- by 40-inch shipping platform by percentage of cases used to ship the items in the nine categories. The average shipping surface utilized was 85 percent, and no more than 33 percent of the cases in any of the nine categories occupied more than 95 percent of the platform's surface. In three categories, nationality foods, breakfast foods, and breads, platform surface utilization was as low as the 65-69 percent range for some of the cases used.

Table 11.—Forty-one modular case sizes identified as possible alternatives for the standard frozen meat, poultry, and seafood cases now used

Case length	Case height
Inches	*Inches*
8 by 8	5, 7.5
10 by 8	5, 7.5
12 by 8	5, 7.5
12 by 10	5, 7.5, 10
16 by 6	5
16 by 8	5, 7.5, 10
16 by 10	5, 7.5, 10, 15
16 by 12	5, 7.5, 10, 15
20 by 6	5
20 by 8	5, 7.5, 10
20 by 12	5, 7.5, 10
20 by 16	5, 7.5, 10, 15
24 by 8	5, 10
24 by 10	7.5, 15
24 by 16	5, 7.5, 10
24 by 20	5, 7.5

Table 12.—Percentage of cases, by category, that utilize different surface areas of a 48- by 40-inch shipping platform

Category	Percentage of shipping platform surface utilized							
	65-69	70-74	75-79	80-84	85-89	90-94	95-100	Average surface utilized
	Percent							
Nationality foods[1]	4	6	14	20	16	22	18	85
Desserts[2]	-	11	23	23	13	21	9	83
Dinners[3]	-	12	15	12	27	22	12	85
Beverages[4]	-	8	17	33	25	17	-	83
Breakfast foods[5]	5	10	20	10	20	20	15	84
Breads[6]	17	12	17	18	6	18	12	81
Fruits[7]	-	-	22	22	12	22	22	87
Snacks[8]	-	-	25	-	25	50	-	87
Miscellaneous[9]	-	-	-	-	33	33	33	90
Average	-	-	-	-	-	-	-	85

[1]Based on 51 cases with different lengths and widths.
[2]Based on 46 cases with different lengths and widths.
[3]Based on 26 cases with different lengths and widths.
[4]Based on 12 cases with different lengths and widths.
[5]Based on 20 cases with different lengths and widths.
[6]Based on 18 cases with different lengths and widths.
[7]Based on 9 cases with different lengths and widths.
[8]Based on 4 cases with different lengths and widths.
[9]Based on 3 cases with different lengths and widths.

Table 13.—Number and percentage of items, by category, that cube out[1] in a highway trailer, and the average payload weights

Category	Items		Average payload weights (pounds)
	Number	Percent	
Nationality foods	87	91	28,600
Desserts	73	96	21,000
Dinners	37	84	30,100
Beverages	1	2	35,200
Breakfast foods	24	88	18,900
Breads	21	91	18,300
Fruits	7	63	36,700
Snacks	5	100	30,100
Miscellaneous	0	0	[2]
Total or average	218	66	24,800

[1]See text footnote 5 for definition of "cube out."
[2]All four items in the miscellaneous category weigh out and average payload weight is therefore, not shown. (See text footnote 7 for definition of "weigh out.")

Table 14.—Thirty-six modular case sizes identified as possible alternatives for the cases used in nine categories[1]

Case length and width	Case height
Inches	*Inches*
8 x 8	5
10 x 8	7.5
12 x 8	5, 7.5, 10
12 x 10	5, 7.5, 10, 15
16 x 6	5
16 x 8	5, 7.5, 10
16 x 10	5, 7.5, 10
16 x 12	5, 7.5, 10, 15
20 x 8	5, 7.5, 10
20 x 12	5, 7.5, 10, 15
20 x 16	5, 7.5, 10
24 x 8	7.5
24 x 10	5, 7.5, 10
24 x 16	7.5, 10

[1]See table 13 for identification of the nine categories.

Many of the items in these categories cube out in a straight trailer load. Consequently, no more cases can be loaded into a highway trailer, although the total payload weight is below the legal limits. Table 13 shows the percentage of packed items, by category, that cube out in a highway trailer before the payload weight of 45,000 pounds is reached, and the average payload weights. Besides the miscellaneous category, which has only four items, the beverage category has the lowest percentage of items cubing out (2 percent) because of the high density of the product items. In contrast, from 88 to 100 percent of the items in nationality foods, breads, breakfast foods, desserts, and snacks cube out. Overall, 66 percent of the items cube out in a highway trailer before the maximum payload weight of 45,000 pounds is reached.

The average payload weight ranges from 18,300 pounds for breads to 36,700 for fruits. The average weight for all categories is 24,800 pounds, which is 55 percent of the maximum payload weight that a trailer can legally carry.

The average shipping platform had an 85 percent utilization (table 12). If 100 percent could be utilized, the average payload weight could be increased from 24,800 pounds to 28,250 pounds, for 3,720 additional pounds.

The 241 case sizes used for frozen items in the nine categories were compared with the previously described 16 modular sizes and the four potential alternative case heights.

The 241 sizes included 21 case height ranging from 3 to 13 inches. Each of the 21 heights was compared with one of the four alternative heights. Nineteen percent of the cases met exactly one of the four alternative heights, and 74 percent of the cases were within 1 inch of one of the four alternative heights.

The 241 case sizes also included 29 lengths ranging from 9.5 to 25.5 inches, and 21 widths ranging from 6.5 to 18 inches.

Fourteen of the sixteen modular sizes are applicable for items in the nine categories. When the four alternative heights were considered, 36 case sizes (different combinations of height, length, and width) were chosen as possible substitutes for the 241 cases now used, a reduction of 86 percent. Ninety-seven percent of the 241 cases now used differ from the 36 potential substitute cases by no more than 2 inches in height, length, or width. The other 3 percent are within 2.5 inches. Because 31 of 36 case sizes have already been identified as substitutes for frozen vegetables and meat, poultry, and seafood, only 5 new case sizes need to be added to the total list.

Table 14 shows the 36 case sizes identified as possible alternatives for cases in the nine categories.

Discussion

In a straight trailer load, more than 63 percent of frozen food items cube out in a highway trailer before 45,000 pounds is reached, partly because the cases in which they are shipped utilize an average of 85 percent of the shipping platform's surface. The average trailer payload for all of these items involved in the study was almost 29,000 pounds.

If case utilization of the shipping platform's surface were improved, the net weight of the trailer load would be increased. Platform surface utilization can be improved through the use of cases that better adapt to the 48- by 40-inch surface. The use of one or more of the 16 modular sizes with a few selected heights would improve utilization of the shipping platform's surface and the transport vehicle, and improve the stability of mixed case loads.

When surface utilization is high (85 percent or greater) and net weight of the load approaches 45,000 pounds, the benefits of improved surface utilization will not be as great as when surface utilization and weight of load are low.

Examination of frozen food case sizes revealed that 98 percent (596 out of 604 case sizes) of the cases now used are within 2 inches of one of the 16 modular case sizes and one of the four alternative heights. The other 2 percent of the cases are within 2.5 inches in height, length, or width. A total of 49 alternative modular case sizes were identified as possible replacements for cases now used, a reduction of 92 percent. The potential replacement cases identified were given individually for vegetables; meat, poultry, and seafood; and other categories. Table 15 shows all of the 49 possible replacement sizes.

Table 16 shows the length, width, and height combinations that form 49 potential modular substitutes for the 604 case sizes now used to ship the 15 categories of frozen food items involved in the study. The 16- by 10-inch size could replace a greater number and percentage of presently used sizes than could any other modular size, and the 20-by 6-inch size could replace the lowest number and percentage. By eliminating some of the modular sizes that can replace only a small number of presently used sizes, the number of alternative modular sizes that the industry could adopt could be reduced below 49.

The height of the modular unit[10] is another very important factor. Most of the frozen food industry has already agreed that 48- by 40-inches should be established as the standard length and width of platforms used to ship frozen food. Now the height of the modular unit must be considered. To date, heights of 22 inches and 45 inches have been recommended and are being used by some of the major frozen food processors. With a combination of these heights, the interior height of a highway trailer can be adequately utilized.

The information presented in this report is only a starting point, intended to stimulate a dialogue among processors, carriers, and receivers. It is up to the frozen food industry to see what can be done to reduce the number of case sizes now in use. Different departments within individual companies must agree on compromises if the number of case sizes now used is to be reduced. Also, companies and various segments of the industry must agree on compromises if the total number of sizes now moving through the distribution channel is to be reduced.

Table 15.—Forty-nine alternative case sizes identified as potential substitutes for the standard sizes.

Case length and width	Case height
Inches	*Inches*
8 x 8	5, 7.5
10 x 8	5, 7.5
12 x 8	5, 7.5, 10
12 x 10	5, 7.5, 10, 15
16 x 6	5, 7.5, 10
16 x 8	5, 7.5, 10
16 x 10	5, 7.5, 10, 15
16 x 12	5, 7.5, 10, 15
20 x 6	5
20 x 8	5, 7.5, 10
20 x 12	5, 7.5, 10, 15
20 x 16	5, 7.5, 10, 15
24 x 8	5, 7.5, 10
24 x 10	5, 7.5, 10, 15
24 x 16	5, 7.5, 10
24 x 20	5, 7.5

[10]The height of the modular unit means the total height of the layers of cases and that of the shipping platform when handled as a single unit.

Table 16.—Length, width, and height combinations forming 49 potential modular case substitutes for the 604 case sizes now used

Modular case sizes		Number of present case sizes modular size could replace	Percentage of present case sizes modular size could replace (length and width only)
Length and Width	*Height*	*Number*	*Percent*
8 x 8	5	1	.3
	7.5	1	
10 x 8	5	3	.8
	7.5	2	
12 x 8	5	29	9.3
	7.5	24	
	10	4	
12 x 10	5	47	11.8
	7.5	14	
	10	9	
	15	1	
16 x 6	5	19	4.5
	7.5	7	
	10	1	
16 x 8	5	29	14.4
	7.5	47	
	10	11	
16 x 10	5	52	21.4
	7.5	58	
	10	16	
	15	3	
16 x 12	5	34	12.1
	7.5	26	
	10	10	
	15	3	
20 x 6	5	1	.2
20 x 8	5	10	5.6
	7.5	19	
	10	5	
20 x 12	5	14	6.0
	7.5	13	
	10	7	
	15	2	
20 x 16	5	7	4.0
	7.5	8	
	10	8	
	15	1	
24 x 8	5	1	1.0
	7.5	4	
	10	1	
24 x 10	5	2	2.1
	7.5	7	
	10	3	
	15	1	
24 x 16	5	6	4.0
	7.5	12	
	10	6	
24 x 20	5	4	2.5
	7.5	11	
		604	100

☆U.S. Government Printing Office : 1986 - 180-917/40677